



COURTESY OF FRANK HEART

**Model A:** The BBN team poses with the first message processor. Team leader Heart is in the center, with tie.

# The Birth of the Internet

**Technology:** The builders of the Net talk about how they changed the world

BY BARBARA KANTROWITZ  
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**I**N THE SUMMER OF 1969, NOT EVERYONE was at Woodstock. In laboratories on either side of the continent, a small group of computer scientists were quietly changing the future of communications. Their goal: to build a computer network that would enable researchers around the country to share ideas. That network became the foundation of the Internet, the vast international computer network that today has become one part buzzword, one part popular obsession. But its birth required a leap of the imagination. Instead of seeing computers as giant, plodding number-crunchers, they had to be viewed as nimble tools that could talk to each other. After that paradigm shift, the rest was just doing the calculations.

That sounds deceptively easy today, in this time of modems that spit out whole textbooks at what can seem like the speed of light. But it took a few visionaries, along with teams of engineers and programmers, to bring the Net to life. Next month in Bos-

ton, many of those pioneers plan to gather for a reunion sponsored by Bolt Beranek and Newman, Inc. (BBN), an important contractor on the 1969 project. For scientists who have spent their careers looking ahead, it's a rare chance to reflect on the past. "It's a bit like climbing a mountain," says Vint Cerf, then a UCLA graduate student and now president of the nonprofit Internet Society and a senior vice president at MCI. "You don't know how far you've come until you stop and look back."

The project was called ARPANET, after the agency that paid for it—ARPA, the Department of Defense's Advanced Research Project Agency. The scientists "tackled the job with a passion, the passion of getting something important done," says author Katie Hafner, who is writing a book on the ARPANET. "The technical foundations they built in 1969 are still in place today." At the time, there was no standard computer operating system: machines generally could

not communicate with each other. The result: a technological Tower of Babel. Even with machines that were compatible, the best way to get data from one to another usually was to physically carry magnetic tapes or punched cards and insert them into the other machine.

Such clumsiness frustrated some of the most talented computer scientists, including J.C.R. Licklider and Robert Taylor, both of whom served stints running ARPA's computer research program in the early and mid-1960s. Like colleagues scattered around the nation, they were thinking of ways to make computers more efficient by connecting them in networks. And they





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had access to the mother's milk of science: grant money. Taylor recalls walking into the ARPA director's office in February 1966 and asking for money. "The conversation lasted about 15 or 20 minutes," he says. "He immediately liked the idea and took a million dollars out of some ARPA project—I never did know which one—to get me started." In 1968, Licklider and Taylor published a particularly prescient paper suggesting that computers could serve as communications devices. They pushed for an experimental network, one that would create new communities of scientists separated by geography but united by technology.

The initial plan was to link four sites:

UCLA, the University of California, Santa Barbara, the Stanford Research Institute and the University of Utah. The first "node," as the network sites are called, was at UCLA. Graduate students Cerf, Steve Crocker and Jon Postel, among others, were enlisted to build hardware and software that would hook up to devices BBN was building for each site. These devices were called IMPs, for Interface Message Processors, and their job was to route data between nodes, making sure the information got to the right destination.

UCLA's node was set up in September and, by working round the clock, the scientists were ready for the first official demon-



JAMES D. WILSON—NEWSWEEK



RAFAEL LUCCHI

**Pioneers:** Postel, Crocker and Cerf use zucchini, tin cans and drawings to represent the primitive Net they helped create. (And you thought computer jocks had no humor!) Engelbart, top, with a modern mouse; his lab at SRI was the site of an early 'node.' Heart, above, at BBN.

stration on Nov. 21. Around midday, Crocker says, a half-dozen scientists gathered at UCLA's Boelter Hall, home of the computer-science department, and watched as one computer hooked up with another hundreds of miles away at Doug Engelbart's lab at the Stanford Research Institute. It was a historic event, but the only visual record is in the memories of those who were there. "There wasn't a photographer present," says Crocker. "and it didn't occur to us that we should have one."

What did the first message say? What was the equivalent of "Mr. Watson, come here. I want you"? Hardly anyone remembers. "The connection worked," says Crocker. "That was all that mattered."

**More sites:** By 1971 there were nearly two dozen sites, including machines at MIT and Harvard. Three years later there were 62 and, by 1981, more than 200. Lawrence Roberts, who succeeded Taylor at ARPA, is credited by many of his colleagues with being the true guiding force behind the network's development. "As far as I am concerned, he is the star of the show," says Engelbart, who is himself a legend in the computer world for inventing (among other things) the mouse.

One of Roberts's hurdles was getting resistant scientists around the country to cooperate. "I told all of the people who were getting computer money from ARPA... that they were going to participate in this," Roberts recalls. "They hated it. They had their own computers, their own thing... They wanted to keep it to themselves... But

I encouraged them to do it because we had the money. I told them they *had* to do it."

Within a year, says Roberts, "they loved it... They got much more sharing of information. They were writing papers together even in the first days." Taylor remembers that, early on, the network also began evolving into more than just a scientific tool. Their computers may have been very different in size and speed, but now they could all talk to each other. Electronic mail caught on quickly. There were heated online political debates, especially over the Vietnam War, and intense conversations about Space War, one of the first computer games.

By the early 1970s other countries wanted to join in. That meant a new technical challenge: how to link up networks around the world. Cerf, then a professor at Stanford University, and Robert Kahn, who was at ARPA, developed a set of technical standards, called protocols, that multiple networks could use. That paved the way for the Internet. Over the next decade dozens of new networks were born, including the USENET news groups, an electronic forum now used by millions of people around the world to discuss everything from particle physics to Barney the dinosaur.

As personal computers became cheaper and easier to use in the late 1980s, anyone with a modem could get online. By that time NSFNET, a network established by the National Science Foundation, served as the technical backbone of the Internet in this country. ARPANET, its job complete, went out of commission in 1990.

**'Democratic spirit':** Technologically, the Internet is a universe away from ARPANET, but there's a kinship of purpose. The founders "really wanted to share computer resources," says Hafner. "It was a very democratic spirit. The spirit in which the network was built you can still see in the network today." In cyberspace, where everyone's words look the same, national boundaries and social distinctions become less important. "I like the one-worldness that the Internet brings to people," says Taylor, now an executive with Digital Equipment Corp., "the fact that people can get more closely connected based on common interests, mutual objectives, mutual need." Frank Heart, who worked on the ARPANET at BBN, compares the experience to early atomic research, space exploration or cracking genetic codes.

Sometimes Steve Crocker, now vice president at Trusted Information Systems, Inc., in Maryland, watches in amazement as two guys hunch over computers linked by a cable strung across an airplane aisle. "And you know the most likely brand name on those computers? It's Nintendo, and the two guys are usually 10-year-old boys. The communication between those two machines is every bit as complicated—if not more so—than what we were envisioning 25 years ago."

Despite their achievements, the network pioneers remain unknown outside the computer world. Often, Kahn says, he will talk about the Internet with a new acquaintance who doesn't know his history. "After I answer two or three questions, they always ask: 'What book did you read?'" But Kahn doesn't like to dwell on the past. "Those were very exciting days, but there are new frontiers in every direction I can look these days."

Quarter century later, the future still looks bright.

# In This Game It's Hard to Root for Either Side

## Sports: A strike may abort a grand baseball season

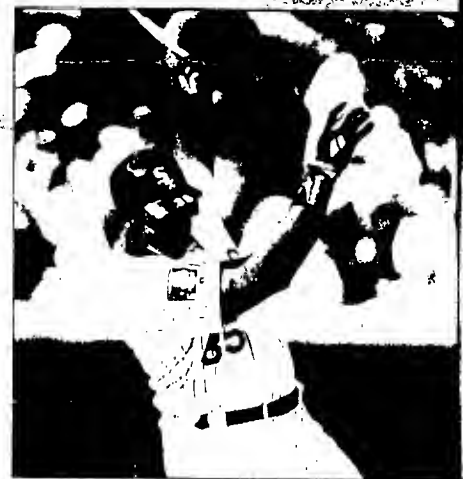
**I**F SHAKESPEARE WERE STILL WORKING, he could do worse than writing about sports. He'd have his tragedies (Jennifer Capriati, Tonya and Nancy, O. J. Simpson) and his comedies (George Foreman's umpteenth comeback, Michael Jordan's second career). And now, with baseball's impending players' strike, he'd examine both sides, measure their comparative villainy and repeat one of his famous phrases: "A plague o' both your houses."

The two houses of baseball met last week

in New York and set what appears to be an irrevocable course toward baseball's eighth work stoppage in just 22 seasons. The players rejected the owners' proposal to combine revenue-sharing with a salary cap, an artificial lid similar to ones in the National Basketball Association and the National

## Broken Records

**B**aseball has been fun again this season, in part because so many of the game's records have been under sustained assault. A strike will end all that. Here's a look at what's at stake.



**TRIPLE CROWN:** Frank Thomas of the White Sox would be the first player since 1967 to lead his league in average, home runs and RBI

## AT THE TABLE

**FOR THE OWNERS:** As a public servant, Ravitch earned a fine rep. Will that survive his work for the belligerent owners?



**UNION MAN:** Fehr and the players have the longest winning streak in sports. Will it end over a salary cap?